ON THE

NORMAL TEMPERATURE

OF THE BODY

IN INFANCY AND CHILDHOOD.

BY

JAMES PATTERSON CASSELLS, M.D., M.R.C.S., Lond.

REPRINTED FROM THE GLASGOW MEDICAL JOURNAL.

GLASGOW:

JAMES MACLEHOSE, 61 ST. VINCENT STREET,

Bookseller to the University, and to the Faculty of Physicians and Surgeons.

1867.

ON THE

NORMAL TEMPERATURE OF THE BODY

IN INFANCY AND CHILDHOOD.

WHILE investigating some of the diseases of early life by the aid of the thermometer, but more particularly during the recent epidemic of measles, much surprise was created by the low temperature of the body in some of the little patients on recovery.

That this might have been caused by the weakness of the vital power, or other circumstances resulting from the disease, was possible, while a suspicion existed that the temperature of the healthy adult in sheltered parts on the surface of the body —98°$\frac{2}{5}$—was too high a standard for infancy and childhood.

With the object of ascertaining the normal temperature at different ages in early life, at stated hours, and for limited periods, a series of experimental observations were begun on healthy children.

When the subject is viewed physiologically, a high temperature would be expected, seeing that the production and maintenance of heat depends upon the rapidity and amount of vital power existing in the body, and that the "characteristic of infantile life is the maximum of rapidity of the vital processes" (Smith, *Health and Disease*, par. 482); but the observations presently to be referred to seem to set that aside, and

the statement made by a high authority that the temperature of children is about 2° higher than that of adults (Bennet's *Outlines of Physiology*, p. 86) is met by the facts represented in the accompanying diagrams, which, so far as they go, upset that opinion.

So far as known, the subject of this paper has not hitherto engaged the attention of the profession, but the experiments made are placed before it, not as a complete solution of the doubts which have arisen, but rather to call the attention of others who are working in the same field to pursue the subject to a satisfactory conclusion.

It may at once be mentioned that the thermometers used were Dr. Aitken's, made by and obtained direct from Cassella; that all possible sources of error were avoided, the children being in perfect health, and asleep for some time before and during the observations.

In every case the bulb of the instrument was in close contact with, and completely surrounded by the tissues, and remained so for not less than twenty minutes, while frequently the time was much longer, and in no case was the temperature recorded until the column of mercury had remained steady for five minutes.

In these experiments, the groin was selected for the application of the instrument. It was so chosen as a part of the body in children easily accessible, always covered by the integument and the clothing of the child or bed, and least liable to be influenced by changes in the temperature of the external or surrounding air.

That the difficulty mentioned at the outset of this paper may be understood, two diagrams are presented (Nos. 1 and 2) out of several cases which came under observation at the same time.

The history of Wm. M'M., whose case is represented in diagram No. 1, was as follows:—Age 2 years, previously healthy, town born, but of good physique, was seized with symptoms of chest affection on the evening of the 17th of June, and was first seen professionally on the 18th, at 8 p.m., being

the second day of the attack. On examination, the physical signs were those of acute pneumonia limited to the lower parts of both posterior lobes, and the thermometer placed in the axilla recorded a temperature of 103⅖°, with the co-relation of respiration and pulse as represented in the diagram. The treatment was exceedingly simple, consisting of small doses of Liq. ammon. acet. and spirit of nitric æther, with large warm poultices to the back of chest, and nutritive food, while attention was directed to keeping the atmosphere of the room moist and warm. He continued to improve under this treatment till the morning of the 5th day of the disease, when the temperature indicated by the thermometer was higher than it had been at the outset, and auscultation revealed a slight increase and extension of the disease. On the evening of the same day the temperature had fallen, although the rate of respiration was the same as in the morning, and the pulse increased in frequency. Next morning, with the temperature the same as the preceding night, the rate of respiration and pulse had diminished, and from that time they continued steadily to fall till the 9th day, when he was so well as to pass from professional care. The rate of respiration on the 8th and 9th days is very high—60—for the temperature recorded—97⅘°—but this may be accounted for by stating that the child was restless and awake, and may have had his breathing accelerated by the presence of a stranger at his bedside: anyhow, it shows the value of the thermometer as a means of diagnosing disease, and giving a sure estimate of the constitutional disturbance, uninfluenced by outward causes.

The temperature on the 9th day, when convalescence was established, being so low, it became of importance to ascertain his normal temperature when thoroughly recovered, and this was done on the 8th August. The observation, as recorded in diagram No. 1, may be looked upon as the normal temperature of his body, and natural rate of the respiration and pulse. The child was asleep for some time previous to, and during the time of, the examination, and was in very good health.

The second case, that of C. P., represented in diagram No. 2,

is fully more interesting, in so far that a careful observation of his normal temperature, with the co-relation of the respiration and pulse, was obtained while in health, and before he had ever been affected by disease, and, again, on the 24th August and 17th September, after he had recovered completely from the attack which brought him under notice. In this case all the observations were taken with the bulb of "Phillip's maximum" thermometer in the groin, and while the child was sleeping.

The history is something similar to the preceding case, the age being 19 months, and the child, when in health, a perfect model. The disease was active congestion of the lungs, and the treatment, under which he got soon well, was of the simplest nature. The records of temperature while suffering from the disease are meagre and unsatisfactory, but are accounted for by the extreme restlessness of the child when awake, and the impossibility of keeping the instrument in contact with the body for any length of time except when sleeping. The chief interest, however, consists in the low temperature of the body before and after the short attack of the disease under which he laboured, and which added strength to the doubts and suspicions previously entertained on the subject.

It has been already remarked that the production and maintenance of heat in the body depends upon the amount of vital power, and as that is a varying quantity, it follows that the heat will vary also, and such, indeed, is the case in adult life but to a less extent in the infant. This is accounted for by the different conditions under which the child lives as compared with the adult, and which have a marked influence on the vital power and heat of the body in early life; for it has been found after careful and repeated observation, that the difference between the two extremes—midday and midnight—of the diurnal range of the temperature of the body, is much less, and more variable than in the adult.

Diagram No. 3 is a record of 82 thermometric observations taken in infants from one to sixteen days old, with the date and hour of each observation.

An analysis of this table is interesting as it shows among

other facts the great fluctuations in the temperature at this early period of life. Again, in every case in which the temperature was taken before the infant had got its natural food, it was found very low, but rose at once after a full meal, and continued so for a variable time and again fell.

If we examine individual cases in the table this fact will appear more striking: thus case 2, Fourteen hours after birth, and after having had the natural food, the heat was 99,° but fell next day $1\frac{1}{5}^{\circ}$.

Case 6, Twelve hours after birth, and after taking the breast milk, the heat was 100,° and next day had fallen 1.°

In cases 5, 7, 9, 12, 13, 16, 17, the temperature was taken a few hours after birth, and before sucking, and the temperature is low, but after taking the natural food the heat is increased in some of the cases more than 1°. The mean temperature of five infants, before food was $96\frac{3}{5}^{\circ}$, in the same after food the mean temperature was $98\frac{3}{5}^{\circ}$.

Cases 14 and 15 are interesting as showing that the children of a plural birth, although they are surrounded by the same influences, have not the same amount of animal heat.

TABLE OF MEAN TEMPERATURE OF 17 HEALTHY INFANTS FROM 1 TO 11 DAYS OLD.

Mean Temperature of	12	infants	on	1st	day,	was $97\frac{2}{5}^{\circ}$.
,,	,,	8	,,	2nd	,,	$98\frac{3}{5}$.
,,	,,	9	,,	3rd	,,	$97\frac{4}{5}$.
,,	,,	9	,,	4th	,,	$97\frac{2}{5}$.
,,	,,	6	,,	5th	,,	$97\frac{2}{5}$.
,,	,,	6	,,	6th	,,	$97\frac{3}{5}$.
,,	,,	4	,,	7th	,,	$97\frac{3}{5}$.
,,	,,	5	,,	8th	,,	$97\frac{4}{5}$.
,,	,,	3	,,	9th	,,	$97\frac{1}{5}$.
,,	,,	4	,,	10th	,,	98
,,	,,	4	,,	11th	,,	$98\frac{1}{5}$.

The low temperature which this table shows is not peculiar to the early days of life: for on examining a healthy child at four weeks old, the temperature was $97\frac{4}{5}^{\circ}$, and, after a lapse of two weeks, the same temperature was recorded; and another healthy child, aged seven months on the 31st July, at 10 p.m.,

asleep, had a temperature of 97°, and the co-relation of while respiration 30, and pulse 110 per minute.

Diagram No. 4. is the record of twenty-seven observations of the temperature of the body, taken morning and evening, on the same child, and under the same conditions with the co-relation of the respiration and pulse.

Proceeding to analyse this table, some points of interest are noticeable, and attention is directed to the diurnal variation in the range of the temperature and the co-relating variation of the respiration and pulse.

The greatest variation in the heat being $2\frac{2}{5}°$, and the least $\frac{1}{5}°$; the greatest variation in the respiration being 10, and the least 1 per minute, while the greatest variation in the same time of the pulse was 10, and the least, 2 pulsations.

The highest morning temperature was $98\frac{4}{5}°$, and occurred on the 8th of June, the co-relation of respiration being 28, and pulse 120 per minute, the heat of the room being 70° Fah.

The lowest morning temperature 97° on the 12th June; the co-relation of respiration 24 and pulse 110; the heat of room 68° Fah.; and the hour and duration of each experiment the same.

The highest evening temperature was 97° on the 7th June; co-relation of respiration 22, and pulse 120; temperature of room 70° Fah.; hour 10 p.m.

The lowest evening temperature was 96° on the 11th June: co-relation of respiration 24, and pulse 112; temperature of room 68° Fah.; hour 11 p.m.; the duration of each experiment being the same.

The mean of 16 observations of the temperature in the morning is $97\frac{2}{5}°$

,,	11	,,	,,	,,	,,	evening	$96\frac{3}{5}$
,,	16	,,	,,	respiration	,,	morning	26
,,	11	,,	,,	,,	,,	evening	23
,,	16	,,	,,	pulse	,,	morning	116
,,	11	,,	,,	,,	,,	evening	109

per minute.

The mean diurnal variation in the temperature of the body being $\frac{4}{5}$.

The curves of the temperature, respiration, and pulse, in

diagram No. 4, beautifully show the increase and decrease in the activity of the vital processes.

The sudden increase of temperature on the mornings of the 8th, 14th, and 20th June, can only be explained by a reference to the variableness of the causes which sustain animal heat in infants, and to the condition of the skin, and the completeness with which it performs its functions, as well as the nature of the food and clothing of the child.

Professor Aitken, of Netley, under whose notice some of these experiments have been brought, has kindly suggested that the temperature be taken at mid-day, that being the period of maximum vital power. No doubt is entertained of the result; the temperature would be higher than in the morning or evening, but still under the temperature of adult life, as will be seen on referring to diagram No. 2, wherein the heat of the body in health at mid-day is recorded.

A series of testing observations were taken in the months of July and August, for the purpose of proving the experiments recorded in diagram No. 4. They are represented in diagram No. 5, and were taken on the same child, if possible with greater care; more time being taken with each experiment.

In those taken in the morning, both thermometers were used at the same time, one in each groin. Those taken in the evenings had the ordinary curved thermometer in the axilla and "Phillip's Maximum" in the groin at the same time, the conditions for this series being the same as in the former experiments.

The attention is at once arrested by the great discrepancies between the temperature recorded on the mornings of the 5th and the 7th August, and the evenings of the 11th and 30th July, for which no plausible explanation can be given. It is clearly not attributable to any error in the experiment, the greatest care having been taken to avoid mistakes.

In this series of experiments—Phillip's Maximum—

	Temp.	Resp.	Pulse.
The highest morning temperature with co-relation of respiration and pulse was, . .	$98\frac{1}{5}^{\circ}$	24	120
The lowest morning temperature, &c., . . .	97	26	114
The highest evening temperature, &c., . . .	$97\frac{2}{5}$	25	100
The lowest " " . . .	$96\frac{1}{5}$	23	106

The mean of nine morning observations by both thermometers was nearly $97\frac{4}{5}°$, and the mean of twelve evening observations was a fraction over $96\frac{1}{5}$.

					Per Minute.
The mean of	5	observations	of the respiration	Morning	25
"	6	"	"	Evening	23
"	5	"	pulse	Morning	110
"	6	"	"	Evening	107

and the diurnal variation of the temperature being about 1°.

Among the suggestions of Professor Aitken is one for the temperature to be ascertained during the time the child is awake; but though repeated thermometric observations have been taken under this condition, they were of such a nature as not to be trustworthy, therefore they are not given. Without doubt the animal heat is greater, but only as a result of the active movements of the child's body.

Advantage was taken on two occasions to test the heat of the body of a healthy robust girl, aged $4\frac{1}{2}$ years, and the result is here subjoined, with the rate of respiration and pulse per minute.

Case of Agnes M——.

	1st August, 1866	2d August, 1866
Date,		
Hour,	9.35 P.M.	9.45 P.M.
Temperature of body,	$97\frac{1}{5}°$	97°
Rate of respiration,	20	22
Rate of pulse,	90	92
Duration of observation in minutes,	15	20

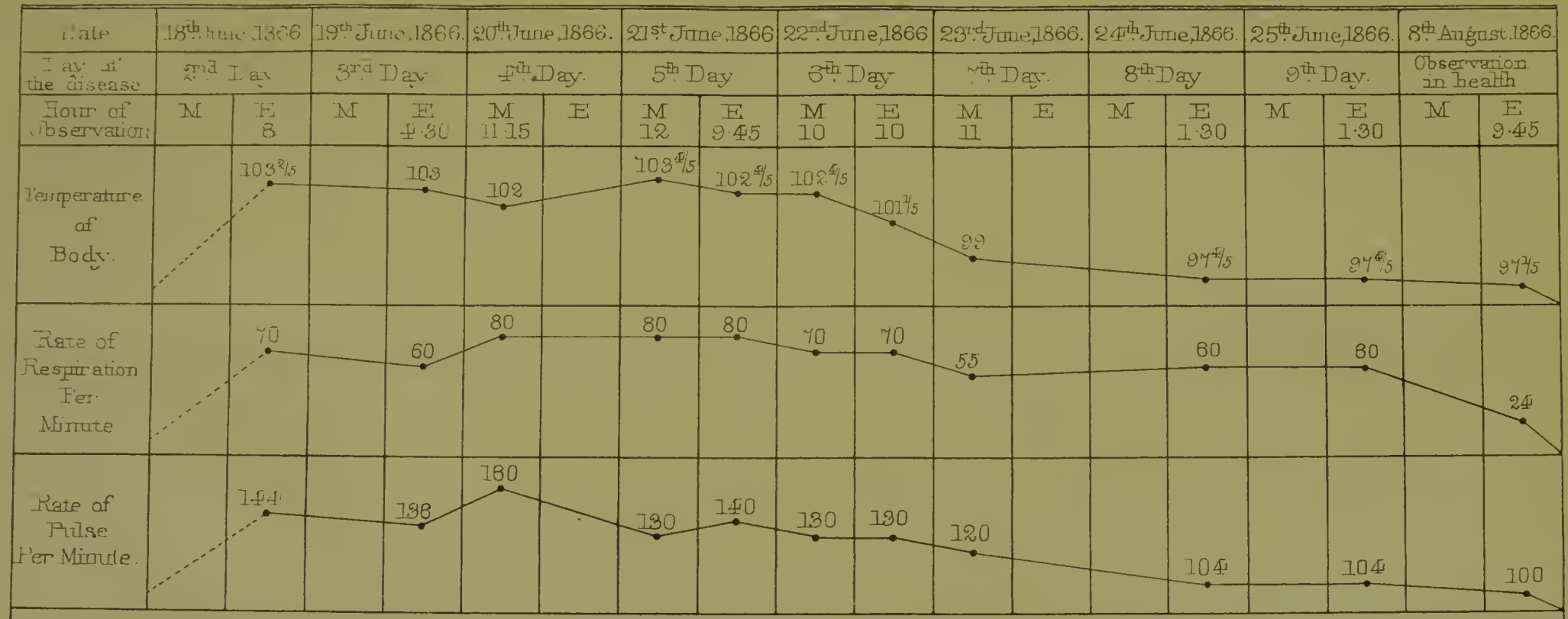
The thermometer was in the axilla, and the child asleep for an hour before and during the time of both experiments.

These experiments, although incomplete as to number, may be relied upon for extreme accuracy, and seem to prove that the temperature of the body in infancy and childhood is lower than that of adult life. No doubt the actual difference is small, but it is very great compared with the statement quoted at the beginning of this paper: whether it is of much practical importance, others must decide. The small number of the

experiments render it impossible to determine accurately the mean temperature of the body in infants and children: but for practical purposes, it will be safe to regard it as $\frac{1}{5}^{\circ}$ lower than in the adult.

Much remains to be done before the questions propounded in this paper can be satisfactorily answered: but so far, the necessity has been shown for accurately fixing the temperature of the body in the earlier periods of life, if the thermometer is to be regarded of value in the investigation of the diseases of infancy and childhood.

DIAGRAM N°1



(M) denotes morning and (E) evening observations, morning is reckoned from 12 midnight till 12 noon and evening from noon to midnight.—
This applies to all the diagrams.

DIAGRAM N°2.

Date	3rd August, 1866.		15th August, 1866.		18th August, 1866,		18th August, 1866.		24th August, 1866.		17th September 1866.	
Day of the disease.	Observation in health.		3rd day of disease.		4th Day.		5th Day.		Observation in health.		Observation in health.	
Hour of Observation	M	E 3·30.	M 11·30.	E 7·45.	M	E 8	M	E 2·30	M	E 3·30	M	E 3·30
Temperature of Body.		98	104 4/5	102 3/5		99 4/5		101 4/5		97 3/5		97 3/5
Rate of Respiration Per Minute.		22	52	50		40		35		20		20
Rate of Pulse Per Minute.		114	134	140		120		132		114		120

		Date, hour, and temperature of the body from 1 day to 16 days after birth by Phillips maximum thermometer in groin.															
N° of Case	Sex	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	M	—	—	—	18th July, 1866. 12 Noon. 97 2/5.	19th July, 1866. 12 Noon. 97 3/5.	—	21st July, 1866 12 Noon. 98 1/5.	—	—	25th July, 1866. 12 Noon. 98.	—	—	—	—	30th July, 1866. 12 Noon. 98 1/5.	31st July, 1866. 12 Noon. 98 1/5.
2	F	8th Augt 1866. 1.45. 99.	9th Augt 1866. 1 Noon. 97 4/5.	—	11th Augt 1866 2 P.M. 95 4/5	—	—	—	15th Augt 1866. 1 Noon. 97 2/5.	—	—	—	—	—	—	—	—
3	F	—	—	—	—	—	—	30th July 1866 12 Noon. 97 1/5	—	—	—	3rd Augt 1866. 1 Noon. 98 3/5	—	—	—	—	—
4	M	—	—	15th Augt 1866 12 Noon. 98	16th Augt 1866. 12 Noon. 97 4.5	17th Augt 1866. 12 Noon. 96 1/5	18th Augt 1866 12 Noon 97 1/5	—	20th Augt 1866 12 Noon. 98.	—	22nd Augt 1866 2 P.M. 97 2/5	—	—	—	—	27th Augt 1866 12 Noon 98.	—
5	F	21st Augt 1866 3·30 P.M. 97.	22nd Augt 1866 12 Noon. 98 2/5	23rd Augt 1866 2·30 P.M. 97 3/5	24th Augt 1866 2·30 P.M. 97 3/5	—	—	27th Augt 1866 3 P.M. 98 1/5.	—	—	—	31st Augt 1866 2·15 P.M. 98 1/5	—	—	—	—	—
6	F	27th Augt 1866 2·30 P.M. 100.	28th Augt 1866. 12 Noon. 99.	29th Augt 1866. 3 P.M 97 3/5	30th Augt 1866 3 P.M. 97 2/5	31st Augt 1866. 2 P.M. 97 4/5.	1st Sept 1866 2 P.M. 97 4/5	—	3rd Sept 1866 2 P.M. 98 1/5.	4th Sept 1866 4 P.M. 98 1/5	5th Sept 1866. 4 P.M. 99.	6th Sept 1866. 8 P.M. 98 3/5.	7th Sept 1866 4 P.M 98	8th Sept 1866. 4 P.M. 98.	9th Sept 1866 12 Noon 98 1/5.	10th Sept 1866 3 P.M 98 1/5	—
7	M	5th Sept 1866 1 Noon. 97 1/5	6th Sept 1866. 12 Noon. 98 1/5	7th Sept 1866 12 Noon 98 1/5	8th Sept 1866. 3 P.M. 97 1/5	—	10th Sept 1866 2 P.M. 97 1/5	—	—	—	—	—	—	—	—	—	—
8	M	7th Sept 1866 3 P.M. 98.	8th Sept 1866 2 P.M 97 4/5	9th Sept 1866. 1 Noon 98 3/5	10th Sept 1866. 12 Noon 97 4/5.	—	—	—	—	15th Sept 1866. 1 Noon. 96 4/5	—	—	—	—	—	—	22nd Sept 1866 2 P.M. 97 1/5
9	F	10th Sept 1866 12 Noon 95 2/5	—	—	—	—	15th Sept 1866 1 Noon. 98.	—	17th Sept 1866. 5 P.M. 98	—	—	—	—	—	—	—	—
10	F	—	—	—	—	15th Sept 1866. 1 Noon. 97 2/5	16th Sept 1866. 4 P.M 97 1/5	—	—	—	—	—	—	—	—	—	—
11	F	—	—	—	—	15th Sept 1866 1 Noon. 97 4/5.	—	—	—	—	—	—	—	—	—	—	—
12	F	21st Sept 1866. 9 P.M. 97 3/5.	—	23rd Sept 1866 1 Noon. 98 1/5	—	—	—	—	—	—	—	—	—	—	—	—	—
13	M	23rd Sept 1866. 1 Noon. 95.	24th Sept 1866. 7 P.M. 97 3/5	25th Sept 1866. 3 P.M 96 2/5	—	—	—	—	—	—	—	—	—	—	—	—	—
14	F	25th Sept 1866. 10·30 P.M. 98.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
15	F	25th Sept 1866. 10·20 P.M. 97 2/5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16	F	2nd Oct 1866. 7 P.M. 97 3/5.	3rd Oct 1866 11 A.M. 98 4/5.	4th Oct 1866 11 A.M. 99 2/5	5th Oct 1866. 9 P.M. 98 3/5	6th Oct 1866. 11·30 P.M. 97 2/5	7th Oct 1866 2·30 P.M 98.	8th Oct 1866. 2·30 P.M. 96 4/5	9th Oct 1866 2·30 P.M. 97 1/5.	10th Oct 1866 2·30 P.M. 98 1/5	11th Oct 1866 2·30 P.M. 97 3/5	12th Oct 1866 11 A.M. 97 3/5	13th Oct 1866 11 A.M 96 4/5.	14th Oct 1866 8 P.M. 97 1/5	—	—	—
17	F	7th Oct 1866. 10 P.M. 96 1/5.	8th Oct 1866. 1 Noon. 97	9th Oct 1866 12 Noon 97 1/5	10th Oct 1866 6 P.M. 96 1/5	—	—	—	—	—	—	—	—	—	—	—	—

DIAGRAM No. 5.

Testing observations taken by both thermometers on the same child under the same conditions. The child asleep on each occasion. In the evening a thermometer was placed at the same time in each groin. In the morning the ordinary curved thermometer was in axilla and Phillips' Maximum in the groin.

1886.

Date	3rd July.	2nd August.	5th July.	5th August.	6th July.	7th August	11th July.	9th August	29th July.	10th August	30th July.
Hour	10·20 P.M.	6·15 A.M.	10·20 P.M.	6·15 A.M.	10·30 P.M.	6·15 A.M.	10·30 P.M.	6·30 A.M.	10·30 P.M.	6·30 A.M.	11·55 P.M.
Temperature of Room Fharenht.	65°	68°	65°	66°	64°	66°	69°	66°	68°	66°	68°
Temperature of Body. Phillips Maximum.	96 3/5	97 2/5	98 2/5	98 3/5	96 2/5	97	97 4/5	Thermometer displaced.	97 3/5	98	97 2/5
Temperature of Body. Curved Thermometer.	96 4/5	97 2/5	98 2/5	98 4/5	96 2/5	97 2/5	96 4/5	97 4/5	97 3/5	98	97 4/5
Rate of Respiration Per Minute.	23	24	22	24	22	26	22	24	25	26	22
Rate of Pulse Per Minute.	106	114	106	120	100	114	112	100	100	104	120
Duration of each observation in minutes.	25	45	30	75	25	45	40	30	25	30	25